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# THE 1B1P MINIATURE DIODE-PENTODE

A. D. Azat'yan

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An article in Radio, No 4, 1950 described the design, characteristics, and operating conditions of the 2P1P miniature pentode [redacted]. This article gives data for the 1B1P diode-pentode which forms part of the same series of miniature battery tubes.

In appearance, over-all dimensions, and locations of pins there is no difference between the 1BIP (Figure 1) and the 2PIP. The 1BIP has a wolfram-oxide filament, the upper part of which passes through the diode plate and is brought out, with the suppressor grid, to the first pin. The second pin is free. Connections with the remaining pins are shown in Figure 1.

The pentode part of the tube, mounted between two mica sheets, is located in the lower part of the bulb. The so-called "boat" getter is fastened under the base of the exhaust seal in the upper part of the bulb.

### Parameters and Operating Conditions

The 1B1P diode-pentode is especially intended for diode detection and audio voltage amplification in economical receivers fed by galvanic batteries. One cell is sufficient for filament heating (1.6 v - 60 ma).

The maximum voltages applied to the electrodes and cathode current are given below. To avoid damaging the tube or shortening its service life, these maxima must not be exceeded, even for a short time.

Maximum plate voltage

lổ v

Maximum screen grid voltage

75 v. 1

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Maximum control grid bias	0 v
Maximum cathode current (sum of plate and grid currents)	4.0 ma
Maximum diode current	250 $\mu$ ma

Voltages applied to the electrodes are determined with reference to the negative filament pin (No 1 pin).

The parameters of the pentode part of the 1B1P are as follows:

Plate voltage	67.5 v
Screen grid voltage	67.5 v
Bias voltage applied to control grid	0 v
Plate resistance, approximate	0.6 megohms
Transconductance	0.625 ma/v
Plate current	1.6 ma
Screen grid current	0.4 ma

The interelectrode capacitances of the pentode part of the 1B1P, when there is no external shield, are as follows:

In	2.2 mfd
Plate grid	0.2 mfd
Out	2.4 mfd

The following operating conditions are recommended for the pentode part of the 1B1P:

Plate supply voltage	45	67.5	90 v
Screen grid supply voltage	45	67.5	75 v
Control grid bias voltage	0	0	0 v
Load resistance in plate circuit	1	1	1 megohm
Resistance in screen grid circuit	3	3	3 megohms
Capacitance of screen grid capacitor	0.1	0.1	0.1 mfd
Resistance in control grid circuit	10	10	10 megohms
Resistance in control grid circuit of following stage	2	2	2 $\mu$ megohms
Stage amplification (in supplying alternating voltage to the control grid from a source with an internal impedance of 1 megohm)	30	40	50

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Characteristics

Figure 2 shows the family of plate characteristic curves of the pentode part of the 1B1P when a voltage of 67.5 v is applied to the screen grid. The dependence of the plate current, screen grid current, and transconductance characteristic on control grid voltage, shown in Figure 4, were taken with 67.5 volts on the plate and screen grid. The curves in Figures 3 and 4 are quantitative representations of the dependence of the currents and transconductance on grid voltages. Economical operating conditions can be readily determined by means of these curves.

Figure 5 shows the characteristics of the 1B1P tube as a triode (screen grid and plate connected). In this type of connection with a 2-ma plate current, the following parameters are obtained: transconductance 0.85 ma/v; amplification factor 14; plate resistance 17,000 ohms.

It is advisable to use the 1B1P tube as a triode when it is necessary to reduce considerably its plate resistance. For greater output, the tube should be operated so that the grid becomes positive during part of the cycle. For this case, Figure 5 gives two curves for voltage values of + 2 and + 4 volts on the grid.

Parameters of the Diode

As stated above, the diode plate is located above the pentode part and includes the end of filament which is brought out to the first pin. The diode is normally used to detect the modulated rf signal. The resulting audio voltage is, at the same time, applied to the control grid of the pentode part of the tube, through the volume control.

The dc component of the voltage, in normal superhet circuits with AVC, is applied to the control grids of the 1A1P and 1K1P hf tubes.

For detection in a battery-operated superhet circuit, the diode part of the tube has quite satisfactory parameters (see Figure 6). To obtain a sufficiently large detection factor, the amplitude of the input voltage must not be less than 0.3--0.4 v. With an rf voltage of several volts and a 2 megohm load resistance, the detection factor will reach 0.9 and the instantaneous positive voltage applied to the diode plate approximately 0.1 of the rf voltage amplitude.

It should be noted that the diode characteristics of individual specimens of 1B1P tubes differ considerably. In some cases the diode plate may have a reduced contact potential. Diode current in such tubes begins to flow when a positive voltage of 0.2--0.4 v is applied to the grid. As a result, the characteristic would be farther to the right than in Figure 6. To obtain satisfactory results in detecting weak signals (tenths of a volt), it is necessary to give the diode plate a small (approximately 0.2--0.3 v) positive bias by connecting the diode load resistance, not to negative filament terminal, but to the high-resistance voltage divider connected in parallel with the tube filament.

Application

The 1B1P diode pentode is intended for diode detection and subsequent audio voltage amplification. Since the parameters of the pentode part are somewhat inferior to the parameters of the 1K1P-type miniature rf pentode, it is advisable to use the 1B1P only when its diode part is employed. When used directly for audio voltage amplification in resistance-coupled circuits, the parameters of the pentode part are admittedly excellent since they permit completely satisfactory stage amplification (See table of operating conditions).

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In an economical variant of a battery superhet, great interest has been shown in utilizing the 1B1P tube in a reflex circuit which permits eliminating one rf pentode from the set of tubes. In this type of circuit the pentode part of the tube serves a double purpose: if (intermediate frequency) amplification before detection and audio amplification after detection.

In order to use the 1B1P tube in if amplification it is necessary to take definite measures against the occurrence of parasitic oscillations. The cause of parasitic oscillations may prove to be the large plate-to-grid capacitance of the tube, whose reactance amounts to only 1.7 megohms at a frequency of 460 kc. The maximum stable amplification obtainable at this frequency is 47. To avoid the use of a neutralizing circuit, it is therefore necessary to reduce the amplification either by decreasing the resonant resistance in the grid and plate circuits of the tube or by reducing its transconductance. Another method of avoiding parasitic oscillations without recourse to amplification reduction is based on decreasing the coupling between the plate and grid circuits. This can be done by reducing the if. The most favorable if for medium- and long-wave receivers is 110 kc, in which case the maximum stable amplification is 96.

Problems concerning filament supply, especially filament connections in series with filaments of other miniature tubes, were treated in detail in the article on "The Miniature 2P1P Tube" in *Radio*, No 4, 1950. We need only add that in series filament supply circuits during normal use of the tube (diode detection and audio voltage amplification in a resistance-coupled stage), the 1B1P filament can be more heavily shunted than the filaments of other tubes, owing to its small cathode current.

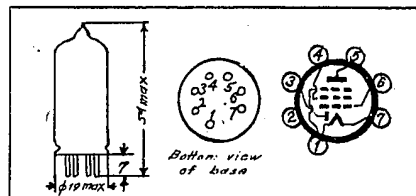


Figure 1. General View and Base Diagrams of the 1B1P Tube

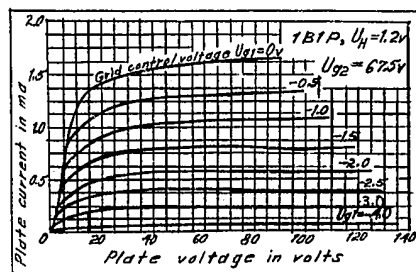


Figure 2. Plate Characteristics of the Pentode Part

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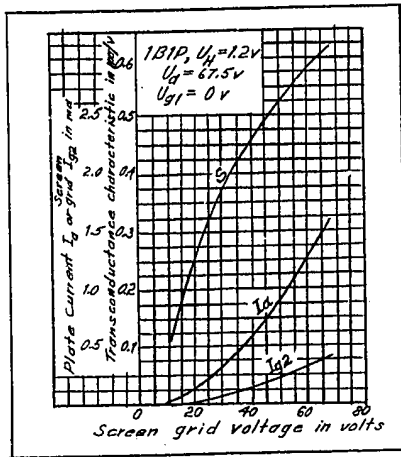
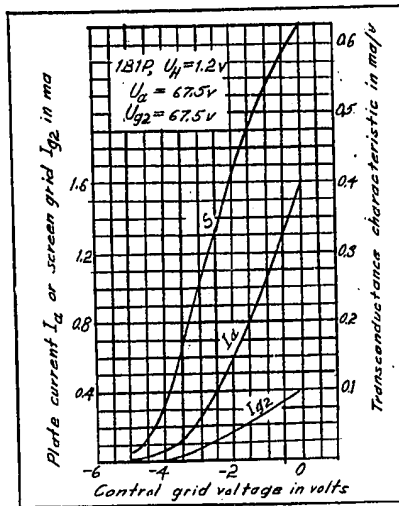
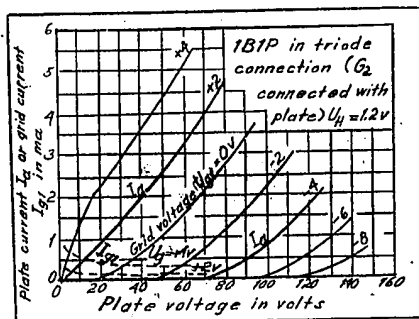
Figure 3. Characteristics When  $U_{g1} = 0$  vFigure 4. Characteristics When  $U_a = U_{g2} = 67.5$  v

Figure 5. Characteristics in Triode Connection

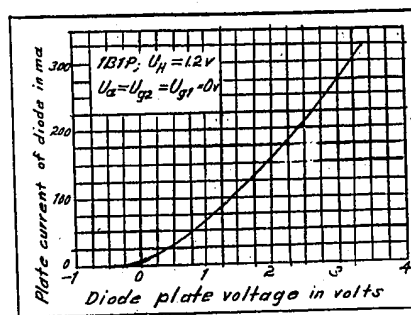


Figure 6. Characteristics of Diode Part of 1B1P Tube

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